

# KOPIO

## WBS Dictionary

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### 1.2.5

WBS Number	Description
1.2.5	<b>Photon Veto</b>
1.2.5.1	<b>Upstream Photon Veto</b> Upstream Photon Veto detectors placed just before the vacuum vessel, which surrounds the decay volume. It consists of 186 sandwich modules readout from 2 ends with WLS fibers and phototubes.
1.2.5.1.1	<b>Log Module</b> Log module is a sandwich assembled of 15 lead-scintillator layers. WLS fibers are glued in the scintillator slabs.
1.2.5.1.1.1	<b>WLS Fibers</b> Multi-clad Y11 wave-length shifting(WLS) fibers manufactured by Kuraray
1.2.5.1.1.1.1	<b>Design</b> Design of fiber readout, optimization of spacing
1.2.5.1.1.1.3	<b>Fabrication/Procurement</b> Production of 210 km of Y11 fibers, selection of fiber cuts, stress tests
1.2.5.1.1.2	<b>Scintillator</b> Extruded polystyrene based plastic with fluorescent dopants
1.2.5.1.1.2.1	<b>Design</b> Optimization of technological modes
1.2.5.1.1.2.3	<b>Fabrication/Procurement</b> Extrusion of 2800 scintillator slabs, mechanical trimming in size

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WBS Number	Description
1.2.5.1.1.3	<b>Reflective Covering/Gluing</b> Covering of the scintillator with chemical reflector, gluing of fibers into the scintillator slabs
1.2.5.1.1.3.1	<b>Design</b>
1.2.5.1.1.3.3	<b>Fabrication/Procurement</b> Covering of the scintillator slabs with chemical reflector, gluing of fibers into the scintillator slabs
1.2.5.1.1.4	<b>Lead</b> Lead sheets of 1 mm thickness
1.2.5.1.1.4.1	<b>Design</b>
1.2.5.1.1.4.3	<b>Fabrication/Procurement</b> Rolling the lead to the calibrated thickness, cutting of the 2800 lead sheets to the required size
1.2.5.1.1.5	<b>Assembly &amp; Test</b> Assembling the sandwich modules from layers of lead and scintillator slabs and test of light output.
1.2.5.1.1.5.3	<b>Fabrication/Procurement</b> Assembling the 186 sandwich modules from layers of lead and scintillator slabs. Optical treatment the fiber readout ends. Optical isolation of logs. Mounting the phototubes housings. Test of light output of assembled modules.
1.2.5.1.1.6	<b>Shipping</b> Packing and shipping the logs from the manufacturer to the BNL
1.2.5.1.1.6.1	<b>Fabrication/Procurement</b> Packing and shipping the logs from the manufacturer to the BNL
1.2.5.1.2	<b>UpstreamVeto Assembling</b> Assembling the Upstream Veto wall from the logs. Connecting the readout instrumentation. Cosmic tests and calibration of the detector.

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WBS Number	Description
1.2.5.1.2.5	<b>Installation/Test</b> Assembling the Upstream Veto wall from the logs. Connecting the readout instrumentation. Cosmic tests and calibration of the detector.
1.2.5.1.3	<b>Instrumentation</b> Photoreadout of the WLS fibers.
1.2.5.1.3.1	<b>Tube Base+Divider</b> HV divider circuit assembly for photomultipliers (380 pcs)
1.2.5.1.3.1.3	<b>Fabrication/Procurement</b> Fabrication of HV divider circuits
1.2.5.1.3.2	<b>Photo Tube</b> Photomultiplier tubes with green-extended photocathodes
1.2.5.1.3.2.3	<b>Fabrication/Procurement</b> Fabrication of 380 photomultiplier tubes with green-extended photocathode
1.2.5.1.3.3	<b>MU Shield+Assembling parts</b> Magnetic shields from m-metal, connectors, mechanical parts for the phototube housings
1.2.5.1.3.3.3	<b>Fabrication/Procurement</b> Fabrication of 380 magnetic shields from m-metal, connectors, mechanical parts for the phototube housing
1.2.5.1.3.4	<b>LV-HV converter</b> Compact hybrid converter of low voltage supply in high voltage for the phototubes
1.2.5.1.3.4.3	<b>Fabrication/Procurement/Test</b> Fabrication of 380 LV-HV converters and their tests before mounting
1.2.5.1.3.5	<b>Cables (2 signal + 2 LV)</b>

## 1.2.5

WBS Number	Description
	Signal coaxial cables ( 2 per channel) with connectors, cable for low voltage supply (12V), low voltage shielded cable for HV control
1.2.5.1.3.5.3	<b>Fabrication/Procurement</b> Production of cables for 186 readout channels
1.2.5.1.3.5.4	<b>Installation/Support</b> Installation of 750 cables.
1.2.5.1.4	<b>Calibration &amp; Monitoring</b> Optical system to monitor the detector performance and stability
1.2.5.1.4.1	<b>Fiber Optics</b> Optical cables to deliver the light from the reference source to the phototubes
1.2.5.1.4.1.1	<b>Design</b> Design of the optical cabling, optical splitters
1.2.5.1.4.1.2	<b>Assembling</b> Routing and connection of optical cables, mounting of hardware parts
1.2.5.1.4.1.3	<b>Fabrication/Procurement/Test</b> Fabrication, preparation and optical treatment of the optical cables and fan-out mixers
1.2.5.1.4.2	<b>Electronics</b> Front-end electronic units to process the reference signals
1.2.5.1.4.3	<b>Light Source</b> The source of the reference light
1.2.5.1.4.3.1	<b>Design</b> Design of the LED based reference light source

## 1.2.5

WBS Number	Description
1.2.5.1.4.3.3	<b>Fabrication/Procurement</b> Fabrication of the light source and its adjustment
1.2.5.1.4.4	<b>Reference PMT</b> The photomultiplier tubes to monitor the stability of the reference light source
1.2.5.1.4.4.1	<b>Design</b>
1.2.5.1.4.4.3	<b>Fabrication/Procurement</b> Production of 2 reference phototubes and their tests
1.2.5.1.4.5	<b>Hardware</b> Mechanical parts for support and routing the fiber optic and light source
1.2.5.1.4.5.3	<b>Fabrication/Procurement</b> Fabrication of mechanical parts for support and routing the fiber optic and light source
1.2.5.1.5	<b>Mechanics</b> Mechanical frame to support the sandwich logs and provide easy moving the Upstream Veto detector out of the setup
1.2.5.1.5.1	<b>Design</b> Design of the support mechanics and service tools
1.2.5.1.5.3	<b>Fabrication/Procurement</b> Production of mechanical parts and service tools
1.2.5.1.5.4	<b>Assembling</b> Mounting the support frame and adjustment to the place.
1.2.5.1.5.6	<b>Shipping</b> Packing and shipping the mechanical frame from the manufacturer to the BNL

## 1.2.5

WBS Number	Description
1.2.5.1.6	<b>Front-end Electronics</b> Electronics to process signals from the phototubes, mounted outside the Upstream Veto detector
1.2.5.1.6.1	<b>Wave Form Digitizers</b> WFD-board has to be including 16 channels of a 10-bit/250 MHz waveform digitizers
1.2.5.1.6.1.1	<b>Design</b> Design of WFD
1.2.5.1.6.1.3	<b>Fabrication/Procurement</b> Production of 25 WFD boards and 2 crates for boards
1.2.5.1.6.1.4	<b>Assembling/Test</b> Test and adjustments of 400 WFD channels
1.2.5.1.6.2	<b>HV Control System</b> System to set and adjust high voltage supply for phototubes with low-voltage levels
1.2.5.1.6.2.1	<b>Design</b> Design of HV control system
1.2.5.1.6.2.3	<b>Fabrication/Procurement</b> Production of 400 channels of low-voltage outputs controlled by computer, production of power modules to supply 12 V for LV-HV converters
1.2.5.1.6.2.4	<b>Assembling/Test</b> Test and adjustments of 400 low-voltage channels to control HV supply
1.2.5.2	<b>Barrel Photon Veto</b> Barrel Photon Veto detector surrounds the vacuum vessel and decay volume. It is assembled of 1100 sandwich modules of shashlyk type in the cylindrical shape.

## 1.2.5

WBS Number	Description
1.2.5.2.1	<b>Shashlyk Module</b> Shashlyk module is a sandwich assembly of 190 layers of lead-scintillator. Light readout is implemented with WLS fibers running across layers. Shape of module is a truncated pyramid.
1.2.5.2.1.1	<b>WLS Fibers</b> Wave-length shifting multi-clad Y11 fibers of 1 mm diameter produced by Kuraray
1.2.5.2.1.1.1	<b>Design</b> Design of fiber readout, optimization of spacing
1.2.5.2.1.1.3	<b>Fabrication/Procurement</b> Production of 570 km of Y11 fibers, selection of fiber cuts, stress tests, thermal and optical treatment
1.2.5.2.1.2	<b>Scintillator</b> Molded polystyrene based plastic with fluorescent dopants
1.2.5.2.1.2.1	<b>Design</b>
1.2.5.2.1.2.3	<b>Fabrication/Procurement</b> Fabrication of 209,000 scintillator plates of 1.5 mm thickness , permanent monitoring of the quality of molded plates
1.2.5.2.1.3.1	<b>Design</b>
1.2.5.2.1.3.3	<b>Fabrication/Procurement</b> Production of Tyvek paper sheets
1.2.5.2.1.4	<b>Lead Sheet</b> Lead plates of 0.5 mm thickness
1.2.5.2.1.4.1	<b>Design</b>
1.2.5.2.1.4.3	<b>Fabrication/Procurement</b> Rolling the lead to the calibrated 0.5 mm thickness, cutting and punching of the 209,000 lead plates

## 1.2.5

WBS Number	Description
1.2.5.2.1.5	<b>Assembly &amp; Test</b> Assembling the shashlyk modules from lead and scintillator plates. Machining of module sides to make a truncated pyramid shape. Optical treatment the fiber readout ends. Optical isolation of modules. Mounting the phototubes housing. Test of light output of assembled modules.
1.2.5.2.1.5.1	<b>Fabrication/Procurement</b> Assembling the 1100 shashlyk modules from lead and scintillator plates and reflector paper. Machining of module sides to make a truncated pyramid shape. Optical treatment the fiber readout ends. Optical isolation of modules. Mounting the phototubes housing. Test of light output of assembled modules.
1.2.5.2.1.6	<b>Shipping</b> Packing and shipping the modules from the manufacturer to the BNL
1.2.5.2.1.6.1	<b>Fabrication/Procurement</b> Packing and shipping the modules from the manufacturer to the BNL
1.2.5.2.2	<b>Barrel Veto Assembling</b> Assembling the Barrel Veto from the shashlyk modules. Connecting the readout instrumentation. Cosmic tests and calibration of the detector.
1.2.5.2.2.5	<b>Installation/Test</b> Assembling the Barrel Veto from the shashlyk modules. Connecting the readout instrumentation. Cosmic tests and calibration of the detector.
1.2.5.2.3	<b>Instrumentation</b> Photoreadout of the WLS fibers.
1.2.5.2.3.1	<b>Tube Base+Divider</b> HV divider circuit assembly for photomultipliers (1100 pcs)
1.2.5.2.3.1.3	<b>Fabrication/Procurement</b> Fabrication of HV divider circuits



## 1.2.5

WBS Number	Description
1.2.5.2.3.2	<b>Photo Tube</b> Photomultiplier tubes with green-extended photocathodes
1.2.5.2.3.2.3	<b>Fabrication/Procurement/Test</b> Fabrication of 1100 photomultiplier tubes with green-extended photocathode
1.2.5.2.3.3	<b>MU Shield+Assembling parts</b> Magnetic shields from m-metal, connectors, mechanical parts for the phototube housings
1.2.5.2.3.3.3	<b>Fabrication/Procurement/Assembling</b> Fabrication of 1100 magnetic shields from m-metal, connectors, mechanical parts for the phototube housing
1.2.5.2.3.4	<b>LV-HV converter</b> Compact hybrid converter of low voltage supply in high voltage for the phototubes
1.2.5.2.3.4.3	<b>Fabrication/Procurement/Test</b> Fabrication of 380 LV-HV converters and their tests before mounting
1.2.5.2.3.5	<b>Cables (2 signal +2 LV)</b> Signal coaxial cables ( 2 per channel) with connectors, cable for low voltage supply (12V), low voltage shielded cable for HV control
1.2.5.2.3.5.3	<b>Fabrication/Procurement</b> Production of cables for 1100 readout channels
1.2.5.2.3.5.4	<b>Installation/Support</b> Installation of 4400 cables.
1.2.5.2.4	<b>Calibration &amp; Monitoring</b> Optical system to monitor the detector performance and stability
1.2.5.2.4.1	<b>Fiber Optics</b>

## 1.2.5

WBS Number	Description
	Optical cables to deliver the light from the reference source to the phototubes
1.2.5.2.4.1.1	<b>Design</b>
	Design of the optical cabling, optical splitters
1.2.5.2.4.1.3	<b>Fabrication/Procurement</b>
	Fabrication, preparation and optical treatment of the optical cables and fan-out mixers
1.2.5.2.4.1.4	<b>Assembling/Test</b>
	Routing and connection of optical cables, mounting of hardware parts
1.2.5.2.4.2	<b>Electronics</b>
	Front-end electronic units to process the reference signals
1.2.5.2.4.2.1	<b>Light Source+ReadOut modules</b>
	The source of the reference light
1.2.5.2.4.2.1.1	<b>Design</b>
	Design of the LED based reference light source
1.2.5.2.4.2.1.3	<b>Fabrication/Procurement/Test</b>
	Fabrication of the light source and its adjustment
1.2.5.2.4.2.2	<b>Reference PMT</b>
	The photomultiplier tubes to monitor the stability of the reference light source
1.2.5.2.4.2.2.1	<b>Design</b>
1.2.5.2.4.2.2.3	<b>Fabrication/Procurement</b>
	Production of 2 reference phototubes and their tests
1.2.5.2.4.3	<b>Hardware</b>

## 1.2.5

WBS Number	Description
	Mechanical parts for support and routing the fiber optic and light source
1.2.5.2.4.3.3	<b>Fabrication/Procurement</b>
	Fabrication of mechanical parts for support and routing the fiber optic and light source
1.2.5.2.5	<b>Mechanics</b>
	Mechanical frame to support the shashlyk modules, provide easy opening to get access to the vacuum vessel
1.2.5.2.5.1	<b>Design</b>
	Design of the support mechanics and service tools
1.2.5.2.5.3	<b>Fabrication/Procurement</b>
	Production of mechanical parts and service tools
1.2.5.2.5.4	<b>Assembling</b>
	Mounting the support frame and adjustment to the place.
1.2.5.2.5.6	<b>Shipping</b>
	Packing and shipping the mechanical frame from the manufacturer to the BNL
1.2.5.2.6	<b>Front-end Electronics</b>
	Electronics to process signals from the phototubes, mounted outside the Barrel Veto detector
1.2.5.2.6.1	<b>Wave Form Digitizers</b>
	WFD-board has to be including 16 channels of a 10-bit/250 MHz WFD
1.2.5.2.6.1.1	<b>Fabrication/Procurement</b>
	Production of 70 WFD boards and 5 crates for boards
1.2.5.2.6.1.4	<b>Assembling/Test</b>
	Test and adjustments of 1100 WFD channels

## 1.2.5

WBS Number	Description
1.2.5.2.6.2	<b>HV Control System</b> System to set and adjust high voltage supply for phototubes with low-voltage levels
1.2.5.2.6.2.1	<b>Design</b> Design of HV control system
1.2.5.2.6.2.3	<b>Fabrication/Procurement</b> Production of 1100 channels of low-voltage outputs controlled by computer, production of power modules to supply 12 V for LV-HV converters
1.2.5.2.6.2.4	<b>Assembling/Test</b> Test and adjustments of 1100 low-voltage channels to control HV supply